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Nutrition—Fundamental to Human Life

TODAY'S average supermarkets offer an amazing array of food items. The number and variety alone would make our great-grandparents blink in awe.

Even more astounding, perhaps, is the fact that no two of our foods are alike. They are unique in their individual make-up—yet each has some of the characteristics of others.

What we eat touches our lives from infancy to old age. Our physical, intellectual, and emotional lives are affected by food, as well as our body's ability to avoid and recover from disease.

We know much more about human nutrition than we did 100 years ago. We've conquered such nutritional deficiency diseases as rickets, goiter, pellagra and scurvy. Life expectancy in the United States today is 72.5 years. Infant mortality has dropped dramatically. This nation has shown greater improvement in health in the past 15 years than has ever been achieved before.

But, compared to other sciences, nutrition is still in its infancy. We understand little about the real effects that dietary changes since World War II have had on human diets and health. There are gaping holes in our knowledge of human nutrient requirements. We haven't begun to find the answers to nutrient questions about pregnancy, infancy, preschool children, obesity, and the elderly—to name a few.

The public is often confused. Conflicting dietary recommendations assail consumers daily. It is difficult for consumers to cope with information often labeled "a new, scientific discovery." And, there is still a great deal of popular ignorance about the caloric value of food.

Nutrition research is a challenging task. Adequate nutrition—fundamental to human life—has in the past, unfortunately, been one of our most elusive goals. Today, our scientists must find the answers to this complex challenge.—*M.M.M.*

COVER: *Blight, a citrus tree disease which has perplexed scientists for decades, is a major concern at USDA's Horticultural Research Lab in Orlando, Fla. In SEA research to measure the extent of blight in individual trees, plant physiologist Roger Young injects water into tubing connected to their roots. Water uptake by the tree will reflect the amount of blight damage. Story begins on page 8. (0278X141–24A).*

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Bob Bergland, Secretary
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SEA biologist Charles Cooper (left) and hydraulic engineer Frank Schiebe monitor a spectroradiometer connected to a solar radiation sensor being held over the water by Cooperating State research technician Steve Scott. Readings are made within 1 hour of solar noon (the midpoint between sunrise and sunset). Sunlight reflected from the water is measured against the light intensity of the sky. The comparative figure provides an index of sedimentation in the water—the higher the ratio, the greater the sediment content (0278X147–9).

New Solar Method Measures Sediment Load

As SURE AS the sun shines, SEA scientists can measure the suspended sediment load of a lake.

Using reflected solar radiation—sunlight—soil scientist Jerry C. Ritchie and a research team have been able to accurately estimate the amount of suspended sediment in four reservoirs.

The studies, conducted over a 3-year period with the aid of a portable spectroradiometer (an instrument that can measure the energy distribution of sunlight), showed a measurable correlation between amount of sediment near the surface of the water and intensity of the reflected sunlight wavelengths.

Prior to development of the solar reflectance technique, measuring sediment loads required numerous water samples. ***Top photo:*** *Dr. Cooper (left) fills bottles with water samples collected at various depths. Later, each sample will be individually analyzed for sediment. Making a related measurement on the right side of the boat, Dr. Schiebe lowers a "Secchi disk" until it drops out of sight—thereby deriving an index on the turbidity (muddiness) of the water based on "disappearing point" figures being recorded by Mr. Scott (0278X145–25).*

Below: *Back at the laboratory, water samples collected by Dr. Cooper are analyzed by technician Kathleen Roush (0278X148–20).*

The studies also showed that the surface sediment data could be used to accurately estimate the sediment in a column of water.

Finally, the scientists were able to use reflected solar radiation to estimate the suspended sediment loads of entire reservoirs.

This method bypasses the time-consuming and expensive method of making the estimates by collecting water samples. The newly developed method also has the advantage of giving what the scientists call a "synoptic" or total estimate of the sediment load in a body of water.

The recently completed research was done using a small boat, and measuring the reflected radiation from approximately one-half meter above the surface of the water.

Studies are underway, however, to determine whether photographs taken from an airplane or satellite could give estimates of the amount of sediment in bodies of freshwater.

Since suspended sediment affects many aspects of a lake or reservoir, the information given by remote sensing would be invaluable to limnologists in their research into the physical, chemical, and biological conditions of bodies of freshwater.

Dr. Jerry C. Ritchie is with the Sedimentation Laboratory, P.O. Box 1157, Oxford, MS 38655.—*B.D.C.*

High Protein Peanut Flour

A NEW METHOD has been developed for the direct extraction of peanuts to produce a product that can be ground into a bland, white flour with high protein solubility that is desirable for food use.

Peanut flour for food use is not new. However, the procedure currently in use, prepress-solvent extraction, subjects the peanuts to high temperatures. High temperatures produce a tan-colored flour and reduce protein solubility, thus decreasing the flour's desirability for some food products.

Working at the SEA Southern Regional Research Center, chemical engineers Joseph Pominski and James J. Spadaro and chemical engineering technician Henry M. Pearce, Jr., have shown that by eliminating high temperatures of cooking and prepressing (the pressure runs the temperature up) to remove oil from the peanuts, the solubility of the protein can be kept high.

The researchers explored a wide range of variables such as heat, heating time, flake thickness, solvent to meal ratio and extraction time.

Although they found that a heat treatment is required to eliminate the raw flavor from the peanuts, they found that temperatures could be held to 180° F. At temperatures above this, the protein solubility value begins to fall. They learned also that optimum moisture content of the peanuts should be held to between 10 and 12 percent.

For best results, the new process involves flaking the kernels to 0.010 to 0.007 inch (although thickness did not appear significant), heating to 180° F. for 30 minutes at 12 percent moisture, then extracting the oil with hexane for 2 hours at a flake-to-hexane ratio of 1 to 2. The extracted flakes are desolventized and ground into flour.

The resulting flour is white and tasteless and contains less than 2 percent oil (the scientists hope to reach less than 1 percent). Protein solubility is about 85 percent (as compared with only about 60 percent for prepress-solvent extracted flour).

The flour, which is almost as white as wheat flour, has been used experimentally in bread and biscuit formulations replacing up to 15 percent of the wheat flour with good results and about doubling the protein content. It has also been used experimentally with good results in ice cream as a replacement for up to one half of the non-fat dry milk solids.

The researchers have also made a very palatable milk from the flour. The milk has a protein content comparable to cow's milk (about 3 percent) and has about the same keeping qualities. When the milk "sours" it also forms a curd, much the way cow's milk does, and researchers are now looking into ways of making some form of cheese-like product.

Messrs. Pominski, Spadaro and Pearce are at USDA's Southern Regional Research Center, P.O. Box 19687, 1100 Robert E. Lee Boulevard, New Orleans, LA 70179.—*V.R.B.*

Topsoil, Stripmines Focus of Research

AVAILABILITY OF adequate supplies of topsoil is a limiting factor for revegetation of some areas disturbed by strip-mining in the Western United States. SEA soil scientist Gerald E. Schuman reports that good quality subsoil mixed with topsoil provides a good growing medium for plants on mined areas. The practice also increases the depth of material that can be spread over mined areas after coal or uranium has been removed.

"Studies show that 25 percent of the specific subsoil we used in the research can be used along with topsoil without harming plant establishment and production," says Schuman.

Because the native soils are generally low in plant nutrients, fertilization is necessary for seedling growth and adequate production, but at rates not considered prohibitively expensive—about 60 pounds each of nitrogen and phosphorous per acre.

In many cases, the mixtures of soils improved both chemical and physical properties of topsoil. Many native soils have limited water storage capacity and, by adding subsoil material with higher clay content, more water can be retained for plant use.

Dr. Schuman's studies are continuing at SEA's High Plains Grasslands Research Station, Route 1, Box 698, Cheyenne, WY 82001, and at three mine sites in eastern Wyoming.—*D.H.S.*

Solar Energy Can Cure Burley Tobacco

One of the four chambers in the solar drying facility is equipped with a buried rock bed for heat storage. Mr. Walton adjusts the time clock that controls discharge of warm air from the bed to the tobacco curing chamber during rainy periods. On Mr. Walton's right are the ducts and blower that pull heated air to and from the rock bed (1077B1343–16A).

SOLAR ENERGY can be an effective substitute for fossil fuel energy in preventing quality losses during curing of burley tobacco.

Value losses of up to 12 percent can result from high humidity and consequent underdrying during curing. To keep the losses to a minimum, farmers have resorted to natural gas, LP gas, and coke as energy sources to lower the relative humidity of the air circulated in curing barns.

In cooperative research, scientists of the Science and Education Administration and the University of Kentucky Agricultural Experiment Station in a study conducted during one season have shown that a properly designed solar energy system probably can achieve results equalling those achieved with fossil fuels.

For maximum effectiveness, a solar facility must overcome the underdrying of burley tobacco that occurs when the relative humidity is above 70 percent.

To compare various concepts with the conventional system, the scientists built a structure made up of four independently operated forced ventilation curing chambers. They were a conventional chamber with a metal roof, a chamber with a fiberglass roof to transmit solar energy, a chamber with a solar collector without heat storage, and a chamber with a solar collector and heat storage system. The latter was designed with a buried rock bed to store collected heat for use over several days during rainy weather or other times when little usable solar energy is available.

During the curing period, the average relative humidity was as much as 5 percentage points less in the fiberglass-roofed chamber and the solar-collector-no-storage chamber than it was in the conventional chamber. But neither the fiberglass-roofed chamber nor the solar-collection-no-storage chamber contributed enough reduction in the humidity to warrant further study.

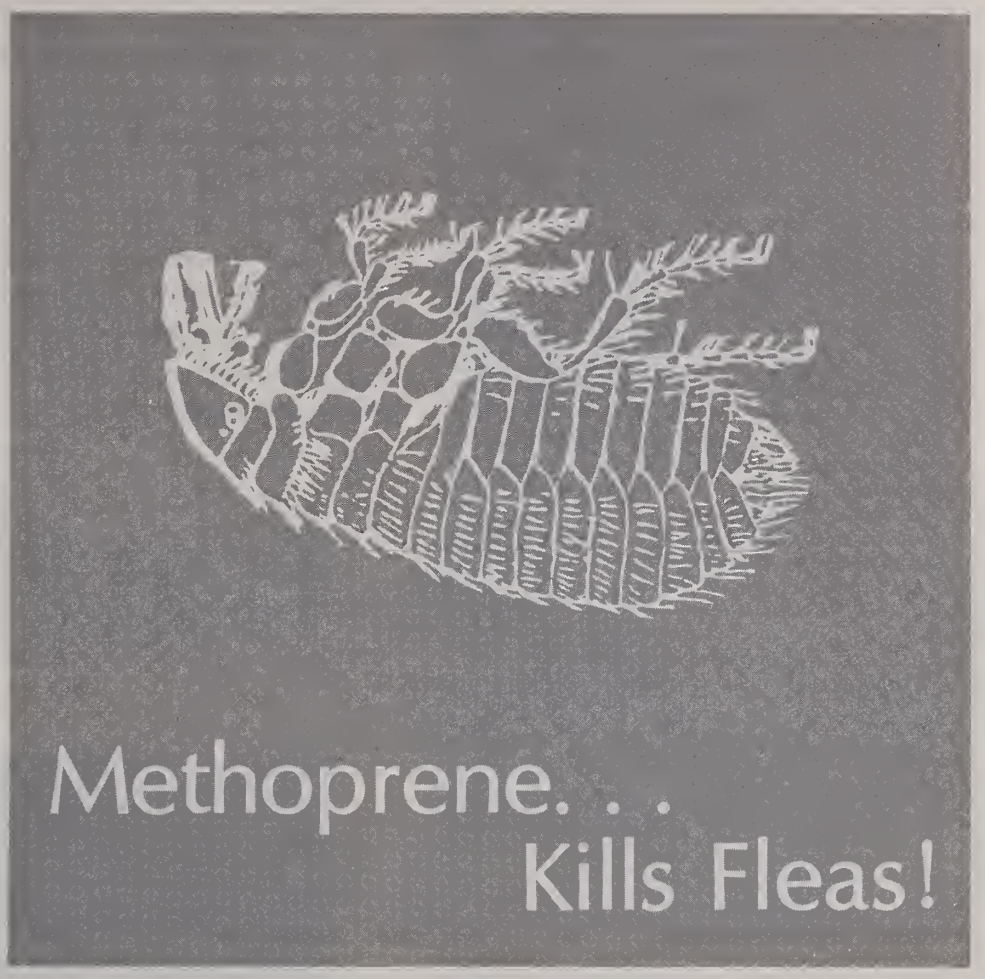
By contrast, the solar-collector-storage system supplied enough heat during a 3-day rainy period to reduce the relative humidity from the 80 to 90 percent range down to the desired 65 to 70 percent range which is necessary to

cure the tobacco effectively.

The research was conducted at Lexington, Ky., by Linus R. Walton and Wiley H. Henson, Jr., of SEA and Samuel G. McNeill, B. F. Parker, and Joe M. Bunn of the University of Kentucky. The research was supported in part with funds from the Energy Research and Development Administration.

Mr. Linus Walton and Dr. Wiley H. Henson, Jr., are at the Agricultural Engineering Building, University of Kentucky, Lexington, KY 40506.—*V.R.B.*

***Below:** Dr. Henson (left) and Mr. Walton inspect a "stick" of burley tobacco cured in the experimental solar structure in the background. This tobacco will be graded for quality by USDA's Agricultural Marketing Service; the grade received is an important criteria in evaluating effectiveness of the new solar-collector-storage system (1077B1342–33).*



AFTER HAVING chalked up victories against a number of other insects, an insect growth regulator has scored again—this time against the flea.

Methoprene, a substance that does not interfere with the growth and development of the immature stages but prevents the survival of viable adult insects, has proven effective against the oriental rat flea. This growth regulator has been cleared by the Environmental Protection Agency (EPA) for use against mosquitoes and horn flies, but it has not yet been cleared for flea control. Entomologist William F. Chamberlain and technician Jo Dean Becker tested methoprene against the oriental rat flea and found it to be 100 percent effective in controlling the pest.

Already shown to be effective in controlling some species of mosquitoes, as well as the cattle horn and face flies and the common housefly, methoprene controlled the flea at the extremely low dosage of only one part per billion.

This research by the SEA Scientists shows for the first time that methoprene can effectively control fleas by preventing cocoon formation and adult emergence. Flea larvae form cocoons in which to pupate, and methoprene disrupts this process. It was far more effective than any of the other 16 compounds tested.

"Flea control is important," said Dr. Chamberlain, "because fleas suck blood from domestic animals such as dogs, cats, and poultry, as well as human beings. They are known to transmit diseases and were the vectors (transmitters) of the plagues that swept over Europe during the Middle Ages."

A further advantage of methoprene is that, unlike some compounds now in use, it is of very low mammalian toxicity.

This experiment was conducted at the U.S. Livestock Insects Laboratory, P.O. Box 232, Kerrville, TX 78028.—*B.D.C.*

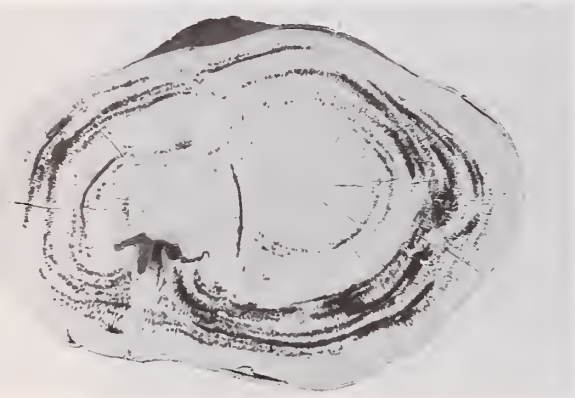
Battleground f

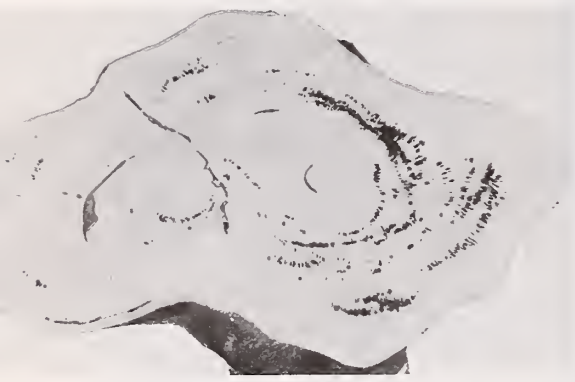
BLIGHT IS a strange and serious malady of citrus trees that has remained a mystery for 100 years. Water uptake studies in blighted trees may be basic to an understanding of what causes it.

Citrus varieties grown on rough-lemon stock are the most susceptible, although trees grown on all commercial rootstocks are affected. Sweet orange and grapefruit varieties, which comprise 90 percent of the citrus in Florida, are both affected by blight. In recent years, losses have totaled approximately 500,000 citrus trees annually in Florida.

An organism or pathogen which causes blight has not been found, and there is no reliable record that a blighted tree ever recovered. Wilt symptoms often develop on one branch of an otherwise apparently healthy tree and spread to the whole canopy. What fruit is produced has high acidity and high solids, characteristics of citrus fruit that develop under moisture stress.

Plant physiologist Roger H. Young and plant pathologist Stephen M. Garnsey, at the U.S. Horticultural Research Laboratory, have developed a model system for studies where both blighted and apparently healthy tissue occur on the same tree. They used sectored trees—trees with portions of the





*Cross-sectioned trunks of dye-injected citrus trees reveal water uptake patterns directly related to citrus blight. Continuous rings of stained tissue from a healthy tree (**top**, PN–4162) demonstrate greater water absorption than do the scattered and comparatively sparse signs of stained tissue from a moderately blighted tree where water movement up in to the trunk was restricted (**bottom**, PN–4163).*

***Right:** Dr. Garnsey adjusts a system of 10 clear plastic tubes for water uptake testing. Opposite ends of tubes, attached to a tapered metal insert, are inserted into holes drilled into major roots and the trunk. Flow of specific amounts of water through the tubes is timed to measure water uptake by the tree (0278X141–34A).*

canopy showing blight—and healthy trees to study water uptake patterns.

"Citrus blight is characterized by a xylem dysfunction—a dysfunction in the inner part of the main portion of the trunk—which causes restricted water movement to the above-ground portion of the tree. An additional characteristic of the disease is the accumulation of zinc in the trunk. We evaluated waterflow patterns in citrus trees exhibiting varying degrees of blight with special emphasis on trees in early stages, where physiological changes may offer the best insight into the cause of the disease," said Dr. Young.

Citrus used in these studies were "Valencia" orange on rough-lemon rootstock and "Hamlin" orange on sour orange and Carrizo citrange rootstocks.

Trees were selected with three stages of blight symptoms: healthy, sectored, and moderate. On sectored trees, one-fourth to one-third of the canopy exhibited typical early symptoms. The sectored portion of the trees was confined to one or two major scaffold limbs located adjacent to each other. All trees selected had blight symptoms less than 1 year.

Waterflow through detached roots was accomplished by a vacuum method. The ability of roots to conduct water was measured by connecting 6-inch root pieces to a vacuum source and to a calibrated water reservoir.

Water uptake through large lateral roots or the trunk was measured by gravity. Holes, 6 by 40 millimeters, were drilled into either roots or trunks and metal injectors were tapped into the hole, 1 centimeter deep. Calibrated polyethylene tubing was attached to the injectors and filled with water to measure water uptake.

To determine the pattern of water movement in blighted trees, easily detected crystal violet (0.1 percent in water) was introduced into large lateral roots by gravity flow. Researchers either sectioned the trees or took trunk cores with an increment borer.

Leaf-resistance measurements, which can be used as an indication of water stress, were made on healthy and blighted trees. Zinc content of trunk samples was determined by standard digestion procedures and quantified by atomic absorption spectroscopy.

"Waterflow through detached roots was about 40 percent less for blighted trees than for healthy trees. Waterflow was impaired in small roots, large major roots, and in the trunks of moderately blighted trees. Waterflow and water uptake were also impaired in the roots on the sectored side of blighted trees," said Dr. Young.

Leaf-resistance measurement indicated that water stress was present in the canopy of moderately blighted trees and the blighted side of sectored trees. Zinc accumulated in trunks of sectored and moderately blighted trees, including both sides of the sectored trees.

Based on the model system where both blighted and apparently healthy tissues occur on the same tree, an extensive team effort is now underway at the Orlando laboratory to determine various pathological, physiological, and biochemical factors associated with the disease.

Dr. Roger H. Young and Dr. Stephen M. Garnsey are at the U.S. Horticultural Research Laboratory, 2120 Camden Road, Orlando, FL 32803.—*P.L.G.*

or Blight

Above: *Using a porometer, Dr. Young and Dr. Garnsey measure leaf transpiration to obtain an index of tree moisture stress. Diseased trees tend to be drier than healthy ones because their roots do not absorb an adequate amount of water (0278X142–31).*

Flow of water through thinner roots is clinically measured by the use of "vacuum pull" technique here being employed by Dr. Young. Water is placed in a calibrated reservoir (left) and drawn through the root by means of a vacuum. The "vacuum pull" technique enables scientists to more rapidly compare healthy and diseased roots from the same tree (0278X144–20A).

Residues — — A Valuable Con

Are all those 330 million tons of corn stalks, soybean stems, wheat straws, and other crop residues grown in the United States going to waste every year? Or, could we burn them for production of electricity, ferment them to make methanol, or compact them for the fireplace?

"There is no question that some of the crop residues produced in this country could be safely removed from the land. Some of this so-called waste material is already used for livestock feed and bedding material," says soil scientist William E. Larson.

How much energy could crop residues provide?

"If all agricultural residues and by-products were collected, dried, and used as fuels, they could supply about 2 percent of the current U.S. energy demand," Dr. Larson says.

"But we make a serious mistake if we pretend that the crop residues left in the fields are wasted. Residues provide our best, cheapest, and easiest erosion control methods, protecting the soil from wind and water erosion. At the same time, residues protect our waters. They increase water infiltration. The residues hold the soil, preventing it from becoming silt in our waterways. They tie up plant nutrients that would otherwise become pollutants in our ground waters, lakes and streams. Residues act as a reservoir for plant nutrients, holding the plant foods for gradual release to new crops the following growing season," Dr. Larson says.

For example, the crop residue from an acre of land that produces 150 bushels of corn will contain about 93 pounds of nitrogen, 15 pounds of phosphorus, and 112 pounds of potassium. If these residues were removed the plant nutrients would have to be replaced by additional fertilizer applications. So, we are not just talking about erosion and water pollution but also fertilizer losses and energy required to produce and deliver that lost fertilizer to the field.

How much crop residue can be removed?

"We can use our computer," Dr. Larson says, "and come up with a pretty accurate prediction about how much residue we can take off a given land area without damaging the environment."

Dr. Larson, stationed at St. Paul, Minn., is the leader of a team of Science and Education Administration scientists and engineers stationed in Minnesota, Kansas, South Carolina, Oregon, and other locations around the country, all working on the residue project.

"There are tremendous differences from place to place," he said. "That's why we use computer technology to collect the information necessary to make an accurate prediction about a given location."

By including soil properties, land slope, average rainfall, cropping and tillage practices of the area, and other factors, we can give a pretty good estimate of how much crop residue can be removed from the land without producing long-term damage from wind and water erosion.

The computer can help us predict how much soil we will lose to erosion if we treat, or mistreat, the land in certain ways.

For example, on sloping wheat lands in Oregon, the computer data indicates that we need to keep all the wheat straw on the land to hold the soil against water and wind erosion.

In Pratt County, Kans., the computer data indicates that if all crop residues were removed from the land the wind would blow away about 45 tons of soil per acre every year from areas with coarse-textured soils. Losses form areas in Pratt County with fine-textured soils would lose about half that much per acre.

On the other hand, the research leader says, "The computer calculations show that we could safely remove 100 percent of the crop residues from 25 percent of the land in the Corn Belt under presently used conventional cultural practices. This applies only to land that is fairly flat and high in organic matter. If farmers used no-tillage conservation practices we could remove nearly half the residues from 74 percent of the Corn Belt acreage.

"However, as farmers are presently using the land in the Corn Belt, even with all residues left on the soil, the Corn Belt is eroding at a rate that will reduce yields in the years ahead."

The computer can give us information on the whole Corn Belt or on units such as Land Resource Areas, having common geography, soils, climate and agricultural use. In hilly Fillmore

nodity

County, Minn., the computer indicates all corn residues are needed to hold the soil from loss to water erosion. On the other hand, in less hilly Martin County, Minn., half the corn residues could be removed safely.

"Such predictions are for long-term planning. Obviously, we cannot predict soil losses for a given day, month or year. We are dealing with averages of weather, crop acreages, tillage methods and so on. But we have enough reliable information to provide a confident estimate of soil erosion under a variety of cultural and residue handling practices for most of the Corn Belt and a few other areas. We are rapidly adding information from other areas," the scientist said.

Those people making decisions concerning land use, establishing regulations concerning erosion, silt, water quality, and other quality-of-living standards should find the computer's output of interest.

Other soil scientists working with Dr. Larson are Dr. Robert F. Holt, North Central Soil Conservation Research Laboratory, Morris, Minn.; Dr. Robert B. Campbell, Coastal Plains Soil and Water Conservation Research Center, Florence, S.C.; Dr. Edward L. Skidmore, Soil Erosion Research Unit, Manhattan, Kan.; and Dr. Raymond R. Allmaras, Columbia Plateau Conservation Research Center, Pendleton, Oreg.

Dr. Larson's address is: Room 201, Soil Science Building, USDA–SEA, University of Minnesota, St. Paul, MN 55108.—*R.G.P.*

Mosquito Control Doesn't Harm Bees

HONEY BEES exposed to an aerial application of fenthion, used to control larval mosquito populations, were only slightly affected by the spray. Only a partial, nonincapacitating loss of bees that were out foraging for pollen and water was experienced, and that effect lasted only 1 day.

This means that beekeepers needn't move their hives—an expensive and time-consuming task—out of areas being sprayed for mosquito control.

Many irrigated mountain meadows provide excellent forage for honey bees. Unfortunately, these same areas are prone to supporting immense mosquito populations that require control. In addition to making life unbearable for humans living in these areas, mosquitoes can cause actual dollar losses in terms of reduced weight gain that have been estimated to be about $25 per beef cow per summer.

The control program using 1/20-pound per acre of a liquid mixture of fenthion caused little harm to the bees, and was successful in controlling the mosquitoes. Liquids are less toxic to bees than dusts, wettable powders or dry flowable materials. The chemical, which decomposed rapidly, was toxic to honey bees for only 24 hours, but effectively controlled mosquito larvae.

The project, conducted on nearly 35,000 acres outside Laramie, Wyo., was a cooperative effort of local ranchers and the University of Wyoming at Laramie. SEA collected and analyzed research data on the project.

Three bee yards with similar environment and forage areas were included in the study. One yard, located 4 miles from the treated areas, served as the control. Another yard and its forage area was directly under the aerial spray application. The third yard was located outside the sprayed area, but close enough so that bees would be foraging in the sprayed area. The spray had very little long-term effect on sprayed bees when compared to the control.

"We are well aware that many pesticides are harmful to honey bees. However, pesticides are used, and we seek those which are least hazardous to honey bees, and yet are successful in controlling target pests," says Mr. Adair Stoner, entomologist at SEA's Bee Disease Laboratory, P.O. Box 3168, University of Wyoming, Laramie, WY 82071.—*D.H.S.*

Evaluating European Wheats

GRAIN TRADE and scientific delegations from Europe often ask: What is the breadmaking value of European wheats in blends with U.S. wheat?

Further discussion leads to a more specific question: How can we evaluate breadmaking quality of wheat flour? Published literature indicates the need for a simple accurate test procedure in Europe.

The baking method used to evaluate flour from U.S. bread wheats at the U.S. Grain Marketing Research Center is such a test. It has proved equally effective for representative European wheat flours. Modifications, because of differences in bread formulas, should not affect usefulness of the Science and Education Administration (SEA) method.

SEA chemist Karl F. Finney found that mixing time was an effective way to differentiate European flours according to their breadmaking properties. He used a mixograph to provide information about such properties of wheat flour. This instrument provides a graph, called a mixogram, which enables scientists to determine three baking properties of wheat flour—mixing requirement, mixing tolerance, and water absorption requirement (AGR. RES. June, 1974, pp. 3–4).

The study further showed that satisfactory to very good bread can be made with 50/50 blends of a flour from typical U.S. hard red winter wheats and flours from European varieties.

Why is SEA concerned about the breadmaking qualities of European wheats? The answer is that close to 60 percent of our wheat crop is exported, and Europe is an important market. In Europe, our wheat is often blended with local varieties that alone are poor or unsatisfactory for making bread. Marked expansion there in acreage of high-yielding varieties unsuitable for bread has emphasized the need for an accurate evaluation technique by these important customers.

Mr. Finney, chemist Y. Pomeranz, and food technologists Lerance C. Bolte and Merle D. Shogren evaluated 22 samples of 1975-crop wheat from Belgium, France, Germany, and Great Britain by SEA methods.

The 14 varieties represented could be classified for breadmaking potential into four groups, the researchers found. Capta from France, Bouquet from Great Britain, and Diplomat from Germany had desirable mixing times and good loaf volume potentials. Kolibri from France had a short but acceptable mixing time and good loaf volume. The remaining varieties either had undesirable mixing times or both undesirable mixing times and unsatisfactory loaf volume potentials.

The researchers then checked the possibility of producing satisfactory bread from blends of 50 percent U.S. hard red winter wheat flour and an equal amount from each of six European varieties. Three of them were rated desirable or acceptable, and three were undesirable in both mixing time and loaf volume.

In each case, bread produced from the blends was greatly improved over bread made with the European flour alone, Mr. Finney said. Three samples with very short mixing times, for example, had desirable medium mixing times in blends with an equal amount of U.S. flour. Loaf volumes and accompanying crumb grain scores, unsatisfactory for three of the six varieties when used alone, were satisfactory for all six blends.

Results of the studies are being made available to European scientists to help maintain or strengthen an important export market for our wheat.

Karl F. Finney is at the U.S. Grain Marketing Research Laboratory, 1515 College Ave., Manhattan, KS 66502.—*W.W.M.*

A Wet-Dry Bin Filler?

THE PROTOTYPE FOR a new device to deliver apples into bins that combines the best qualities of existing types of bin-fillers without the drawbacks has been developed and tested by SEA researchers in Wenatchee, Wash.

Since it is impossible to pack all apples gathered at harvesttime, the apples than cannot be packed should be sorted according to grade and size, returned to bins and stored for later packing. To do this, packinghouse operators need a way of filling bins that is gentle to the fruit, and will maintain a rapid fill-rate, utilize the full capacity of each bin and occupy a minimum space at a cost the medium and small volume packers can afford.

Dry bin fillers have been used by packers for years but these fillers are slow and too often, they severely damage the fruit. Hydrofillers, in which apples are delivered to bin fillers in water, are becoming more popular with packers because they cause little damage to the apples. However, hydrofillers require large floor areas in the packinghouse and great volumes of water, and they incur relatively high capital and operating costs.

To meet the needs of packinghouse operators, industrial engineer Stanley W. Burt, agricultural engineer Gilbert E. Yost and mechanical engineer Glenn L. Patchen designed what they call a wet-dry filler. The wet-dry filler combines a hydrofiller's gentle way of conveying apples with the small space requirements of dry fillers.

The SEA-filler's design is based on the principle of the traveling crane. There is a frame over which a carriage travels laterally from the filling area of a water tank to an adjacent bin. The carriage propels a basket that is used to pick apples up from the filling area and deposit them into bins. Attached to the basket are gates that either hang vertically or else close to form a bottom to the basket. Other equipment includes a tank with a pump for continuous circulation of water and a bin positioner.

Apples are placed into the water tank and the basket (with its gates vertical) is lowered through the apples. Once the basket is submerged below the apples the gates are closed and the basket is lifted out of the tank with a load of apples. The basket is then positioned above and lowered into a nearby bin and the gates are released to hang free. As the basket is lifted from the bin the gates slide out from under the apples leaving the fruit in the bin.

All operations are fully automated. Bruising is about the same as that caused by hydrofillers but the wet-dry filler requires only about one-fourth the water and space required by the hydrofillers. It also puts more apples into each bin and operating costs are reasonable. A further advantage is that the wet-dry filler permits some flexibility in layout as it can be tailored to fit short, wide buildings or long, narrow ones.

Stanley W. Burt and Gilbert E. Yost are at Yakima and Mission Streets, Box 99, P.O. Annex, Wenatchee, WA 98801.—*L.C.Y.*

"The wet-dry bin filler is especially suitable to the smaller operator because of its reasonable cost, the low rate of damage to fruit, and especially because it requires only about one-fourth the water and space of a conventional hydrofiller,"—Stanley W. Burt, industrial engineer, SEA .

Hereford Research. . .A Success

RESEARCH PAYS OFF! The SEA-developed Hereford cattle breed—called Line 1—represents one of the longest continuing beef cattle linebreeding programs in the U.S. and today commands the nation's highest average sales prices for beef breeder bulls.

First established in 1934 at SEA's Livestock and Range Experiment Station, Miles City, Mont., Line 1 Herefords have been maintained as a closed herd with no introduction of either bulls or cows from other herds for 43 years.

The Line 1's have developed into sound Hereford cattle with good conformation and meat quality, and a fast growth rate. Cows are fertile, supply plenty of milk to calves and do well on the range. The Line 1's have become widely accepted by Hereford breeders operating under varying environmental conditions.

SEA animal scientist Ray R. Woodward, who leads the research at the Miles City Station, says that, ". . . we except Line 1 to be a prominent part of the Hereford scene for many years to come."

Dr. Ray R. Woodward is with the U.S. Range Livestock Experiment Station, Route 1, Box 3, Miles City, MT 59301.—*L.C.Y.*

Bovine Leukemia Transmission

TWO ROUTES for natural transmission of bovine leukemia virus (BLV) appear most probable: ingestion of infective colostrum or milk by newborn calves and introduction of the virus through the skin in susceptible cattle of all ages.

Preliminary studies at the National Animal Disease Center, Ames, Iowa, also indicate that saliva, urine, and nasal secretions are not major sources of infection in natural transmission of BLV.

In addition, use of semen from infected bulls for artificial insemination does not appear to present a serious hazard, SEA veterinary medical officer Janice M. Miller reports. But she does not rule out the possibility of venereal infection resulting from natural service by a BLV-infected bull.

Scientists had evidence that most BLV infections result from contact transmission after birth but had not identified exact mechanisms.

International restrictions on movement of cattle carrying BLV have spurred interest in developing control or eradication programs. Information on natural transmission would be essential. And transmission studies became possible with identification of the virus that causes leukemia in cattle and development of specific diagnostic tests (AGR. RES., Dec. 1974, p. 12).

Dr. Miller and veterinary medical officer Martin J. Van Der Maaten of USDA's Science and Education Administration investigated natural sources of BLV and avenues of transmission in a series of studies.

The researchers used sheep as test animals to assay infectivity of secretions and excretions of BLV-infected cattle. Sheep, a species in which leukemia rarely occurs, are nevertheless extremely susceptible to BLV infection.

Four cows experimentally infected with BLV were sources of colostrum or milk which was injected intraperitoneally into sheep. Some of the sheep which were injected with colostrum or milk developed antibodies to BLV which indicated those sheep had been infected. These results indicate the virus was present in the colostrum of one cow and in the milk of three cows. This evidence of infection was confirmed by reisolation of BLV from blood leucocytes (white blood cells) of the sheep. Infectivity of milk from one of two BLV-infected cows in a commercial herd was similarly demonstrated.

Dr. Miller reports none of the sheep inoculated with semen from BLV-infected bulls developed antibodies during 12 months of observation. Neither were antibodies to BLV detected in sheep 4 months after inoculation with saliva, urine, or nasal secretions from BLV-infected cows.

Dr. Van Der Maaten directed a series of experiments to identify how BLV might gain access to susceptible tissues and initiate infections.

He found that newborn calves are more susceptible to oral infection than are older calves. All six newborn calves became infected when they were fed blood leucocytes from a BLV-infected animal. One of two animals became infected when similarly exposed at 3 days of age, but neither of two that were exposed at the age of 3 weeks became infected.

Intranasal instillation of infected leucocytes produced infection in one of two calves 2 to 3 weeks old, and aerosols from fluids of BLV-infected cell cultures produced infections in both exposed calves. Techniques routinely employed for artificial insemination also produced infection in four of six mature cows when blood leucocytes were introduced into the uterus.

Dr. Van Der Maaten reports that five calves were readily infected by inoculating small numbers of blood leucocytes under the skin. He says the marked susceptibility to infection by this route suggests attention to minor trauma, surgical procedures, and external parasites in future studies on natural transmission of BLV.

Dr. Janice M. Miller and Dr. Martin J. Van Der Maaten are at the National Animal Disease Center, P.O. Box 70, Ames, IA 50010.—*W.W.M.*

AGRISEARCH NOTES

Envelopes for Pipe Drains

PIPE DRAINS in coarse-textured subsoils may fill with sediment unless suitable envelopes are installed around them.

Agricultural engineer Leo C. Benz tested 20 different envelope materials at the Northern Great Plains Research Center, Mandan, N. Dak., in cooperation with agricultural engineer Eugene J. Doering and soil scientists George A. Reichman and Ronald F. Follett, all of USDA's Science and Education Administration.

A laboratory cylinder apparatus was developed to test the envelope materials which included gravel and various commercially produced synthetic sheets, cords, blankets, foams, and knits. The gravel envelopes used were constructed from designs recommended by the Soil Conservation Service and the Bureau of Reclamation.

Short-term flow tests showed that all materials had acceptable flow rates, Benz said. Long-term tests of 100 hours showed that flow rates decreased with time for all materials tested. Gravel had the highest flow rates during the test but the largest decrease in flow rates by the end of the long-term test.

"Though average flow rates varied, all envelopes were acceptable," Benz said.

Some of the synthetic sheet envelopes tore under test, which would be expected because the drain corrugations filled with soil and forced the envelope into the corrugations. To be effective, materials must be flexible without losing their envelope qualities, Benz said.

Additional testing is underway to determine materials best suited for use with sandy and unstable subsoils.

Leo C. Benz is with the Northern Great Plains Research Laboratory, P.O. Box 459, Mandan, N.D. 58554.—*R.G.P.*

Black Pepper Kills Bugs

PLACING BLACK PEPPER on a boll weevil in a cotton field may be more practical than placing salt on the tail of a bird. Black pepper, an item readily available in the home kitchen, may one day prove useful for the control of boll weevils in cotton fields.

Researchers used dried black pepper purchased at the supermarket. The ground pepper was extracted for 1 hour in a Soxhlet apparatus with 95 percent ethyl alcohol. The alcohol was then diluted with water in a 1-to-1 ratio and extracted with ethyl ether. The 19.8 grams of black pepper yielded 817 mg of a soft dark green mass after evaporation of the ether. The crude extract was dissolved in acetone at a concentration of 53.3 mg/ml. Six dilutions were made serially from this solution to obtain a concentration range of 53.33–0.833 mg/ml.

The solutions were applied topically to 3- to 5-day-old laboratory-reared boll weevils with a manual microapplicating device fitted with a 1 ml syringe. Each insect received a 1.33 μ l dose of pepper extract or solvent control. Fifty insects were treated with each dose. After treatment, the insects were held in glass petri dishes (10/dish) and maintained at 23–27° C. Mortality counts were made daily for 3 days.

The mortality data confirmed, according to William P. Scott and Gerald H. McKibben of the Boll Weevil Research Laboratory, that black pepper is a natural insecticide capable of suppressing boll weevils in the laboratory. Further analysis of the chemical compounds found in black pepper may permit field evaluation studies to control boll weevils in cotton fields.

William P. Scott and Gerald H. McKibben are at the Boll Weevil Research Laboratory, P.O. Box 5367, Mississippi State, MS 39762.—*E.L.*

Selecting Superior Alfalfa

SELECTING superior alfalfa plants from test plots is not always an accurate indication of how superior they will be under actual field conditions.

"One factor that weighs heavily under field conditions is competition with neighboring plants for light, plant nutrients, and water. Because scientists usually grow plants far apart from each other for easier observation, competition is not brought into breeding programs until they are actually seeded in fields," says SEA agronomist Richard H. Hart in Cheyenne, Wyo.

To eliminate possible errors in selection, Hart developed a mathematical equation for measuring effects of neighboring plants on yields.

"By using this equation, we can see if these superior plants are really super plants or just lucky in having noncompetitive neighbors. If they are truly superior we can recommend their use as parents for breeding programs," said Hart.

Hart, now at Cheyenne, conducted these studies at Beltsville, Md.

Dr. Richard H. Hart is with the High Plains Grasslands Research Station, Route 1, Box 698, Cheyenne, WY 82001.—*D.H.S.*

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Evaluating Grasses

TIME OF FIRST harvest in the spring influences total forage yields of cool season grasses. For example, an orchardgrass variety, which ranked eleventh in yield using an early harvest schedule, moved up to fifth with spring harvest scheduled 3 weeks later. Generally, late maturing orchardgrass varieties had lower forage yield than early varieties, but the late varieties were 2 to 10 percent units higher in digestibility.

These observations by Science and Education Administration agronomist Arthur G. Matches, Columbia, Mo., may give farmers and plant breeders insights on evaluating grasses for differing conditions of management. Dr. Matches said a farmer might use grasses of different maturities to provide a more even seasonal distribution of high quality pasture in a rotational system of grazing. Cool-season grasses that are late maturing could be planted advantageously with some legumes to produce grass-legume-hay with good yield and nutritional value.

Dr. Matches compared yield and quality of 18 varieties of cool season grasses. The grass species were tall fescue, orchardgrass, smooth bromegrass and reed canarygrass.

These experiments, located at Columbia and Mount Vernon, Mo., were a study of methods for better evaluating cool season grasses in small experimental plantings. After making the study, Dr. Matches proposed data measurements that would help researchers make growth analyses of different forages, establish trends in forage quality and provide information for planning pasture systems.

"Evaluating breeding lines of grass in small plots at various stages of growth enables us to determine which lines to study further in larger plots," Dr. Matches said. Some lines are evaluated primarily for hay production and other lines are used in grazing trails.

Dr. Arthur G. Matches is at Waters Hall, Room 207, University of Missouri, Columbia, MO 65201.—*G.B.H.*

Comfrey: Less Than Expected

COMFREY, widely advertised as a superior forage crop, didn't produce as much forage or digestible protein as alfalfa or orchardgrass—two more conventional forage crops.

"Results of a 2-year study indicate that alfalfa and orchardgrass produce about twice as much forage as comfrey—6 to 8 tons per acre versus 3 to 4 tons for comfrey. Furthermore, digestibility of alfalfa and orchardgrass was more than 50 percent greater than that for comfrey—approximately 60 percent versus 40 percent for comfrey," says SEA agronomist Richard H. Hart, Cheyenne, Wyo.

Protein content for all three plant species was about the same (14 to 17 percent), but the protein from comfrey was not digested as efficiently as was protein from alfalfa and orchardgrass.

Comfrey is a tall, leafy perennial that is native to the Soviet Union. It doesn't produce seed so it must be started from roots or cuttings.

The study was conducted at two SEA locations—Cheyenne, Wyo., and Beltsville, Md.

Dr. Richard H. Hart is with the High Plains Grasslands Research Station, Route 1, Box 698, Cheyenne, WY 82001.—*D.H.S.*

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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